

INTRODUCTION:

Health Effects of Creosote

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CREOSOTE IS DERIVED FROM THE DESTRUCTIVE DISTILLATION OF COAL. THE PRODUCT IS A HIGHLY COMPLEX MIXTURE OF AMINES, HYDROCARBONS, PHENOLS, POLYCYCLIC <sup>PAN</sup> AROMATICS, PLUS A LARGE NUMBER OF OTHER ORGANIC COMPOUNDS. THE GENERAL COMPOSITION OF CREOSOTE HAS BEEN KNOWN TO CONTAIN AS MANY AS 200 COMPOUNDS. ON THIS BASIS ALONE COMMENTS WILL BE RESTRICTED TO GENERAL TOXICITY OF CERTAIN MAJOR COMPONENTS WHOSE KNOWN ADVERSE EFFECTS ARE SIGNIFICANT.

CREOSOTE COMPONENTS BOIL AT A RANGE OF 175° C - UP TO 450° C. IT IS IMMISCIBLE WITH AND HEAVIER THAN, WATER. IT HAS AN OILY CONSISTENCY AND VARIES IN COLOR FROM CLEAR AMBER TO DARK GREEN-BROWN.

CREOSOTE CAN BE IDENTIFIED AS A SOURCE OF CONTAMINATION THROUGH CHROMATOGRAPHIC ANALYSIS, IDENTIFYING CERTAIN OF THE COMPOUNDS SUCH AS ACENAPHTHENE, ACRIDINE, ANTHRACENE, FLUORANTHENE, FLUORENE, NAPHTHALENE, PHENANTHRENE, AND PYRENE WHICH ARE PECULIAR TO CREOSOTE WHEN FOUND TOGETHER.

A. TAR ACIDS

THE FIRST GROUP CONSIDERED WILL BE THE TAR ACIDS WHICH CONSISTS OF PHENOLIC TYPE COMPOUNDS (E.G. PHENOL, CRESOL, XYLENOL NAPHTHOLS).

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THESE FOUR COMPOUNDS ARE VERY TOXIC WITH INGESTION OF AS LITTLE AS 14 MG/KG BEING THE LOWEST REPORTED LETHAL DOSE. PHENOL IS RECOGNIZED AS A GENERAL PROTOPLASMIC POISON WHICH IS TOXIC TO ALL CELLS. IT DENATURES AND PRECIPITATES CELLULAR PROTEINS AND CAUSES RESPIRATORY ALKALOSIS. METHEMOGLOBINEMIA MAY ALSO OCCUR. CEREBRAL EDEMA ALONG WITH HEPATORENAL DEGENERATION OCCURS.

ACUTE AND CHRONIC POISONING SYMPTOMS FROM SKIN EXPOSURE ARE EXTENSIVE. IT HAS BEEN POSTULATED THAT EVIDENCE EXISTS THAT, IN MAN, PHENOL TOXICITY MAY BE GREATER WHEN ABSORBED THROUGH THE SKIN OR MUCOUS MEMBRANES THAN WHEN INGESTED.

B-NAPHTHOL ON SKIN CONTACT HAS PRODUCED RENAL TUMORS, HEMOLYTIC ANEMIA AND LENS OPACITIES. PHENOL AND ITS' THREE ISOMERIC CRESOLS PRODUCE IDENTICAL SYMPTOMS IN POISONED ANIMALS AND ALL EXHIBIT TOXICITY OF ABOUT THE SAME MAGNITUDE. ORAL LETHAL DOSE IN RATS (LD 50) IS 414 MG/KG; THE LOWEST REPORTED LETHAL DOSE FOR HUMANS (ORAL INGESTION) IS 140 MG/KG. THE LOWEST REPORTED TOXIC DOSE IS 14 MG/KG, WITH GASTROINTESTINAL DISTURBANCES RESULTING.

MUCH EVIDENCE EXISTS TO INDICATE THAT IN MAN, PHENOL IS CONSIDERED LESS TOXIC BY MOUTH THAN BY WOUNDS, BODY

CAVITIES OR EVEN THE INTACT UNBROKEN SKIN. SKIN NECROSIS HAS OCCURRED WITH CONCENTRATIONS OF 1% PHENOL EXPOSURE.

ABSORPTION OF PHENOLS ON THE SKIN IS KNOWN TO BE VERY RAPIDLY ABSORBED (IN FIVE MINUTES) FROM 60 SQUARE INCHES OF SURFACE AREA, WITH DEATH OCCURRING IN AS LITTLE AS 30 MINUTES. WHERE DEATH IS DELAYED, DAMAGE TO LIVER, KIDNEY, PANCREAS, SPLEEN, AND LUNGS IS NOTED. PHENOL IS ALSO KNOWN TO BE A COCARCINOGEN.

CHRONIC EXPOSURE TO VARIOUS TYPES OF SUCH PHENOLIC COMPOUNDS CONSTITUTE AN UNNECESSARY RISK TO HUMAN HEALTH BECAUSE OF THE EXTREMELY REACTIVE NATURE OF THE PHENOLS. B-NAPHTOL EXPOSURE PLAYS A ROLE IN CARCINOGENESIS, THUS THERE IS NO SAFE LEVEL FOR SUCH COMPOUNDS.

(CRESOLS - EFFECTS ARE SAME AS PHENOL, BUT NOT QUITE SO SEVERE).

B. TAR BASES

CONSTITUTES THE SECOND FRACTION AND CONTAINS SUCH COMPOUNDS AS PYRIDINES, QUINOLINES, ACRIDINES, AND NAPHTHYLAMINES.

PYRIDINE CAN BE ABSORBED BY MOUTH OR INHALATION BUT NOT SIGNIFICANTLY FROM THE SKIN, ALTHOUGH DERMATITIS HAS OCCURRED FROM EXPOSURE. EFFECTS OF 1,121 MG/KG PYRIDINE HAS BEEN LETHAL TO 50% OF A TEST RABBIT GROUP WHEN APPLIED TO THE SKIN. LOWER ANIMALS MAY BE MORE SUSCEPTABLE.

PYRIDINE HAS BEEN FOUND TO BE A PHOTSENSITIZER, ALONG WITH ACRIDINE, ANTHRACENE, AND HEXACHLOROPHENE, ALL OF WHICH ARE FOUND IN CREOSOTE. PYRIDINE HAS BEEN FOUND TO HAVE TOXIC EFFECTS UPON VARIOUS MEMBERS OF THE AQUATIC COMMUNITY INCLUDING ROOTED PLANTS.

THE ACRIDINES AS A GROUP ARE STRONG IRRITANTS TO THE SKIN AND MUCOUS MEMBRANES. ACRIDINE IS CONSIDERED TO BE THE EFFECTIVE IRRITANT IN TAR AND CREOSOTE.

QUINOLINES HAVE RETINOTOXIC PROPERTIES AND ARE CONSIDERED MODERATELY TOXIC. THEY DO NOT APPEAR TO PLAY ANY SIGNIFICANT ROLE IN TOXIC MANIFESTATIONS OF CREOSOTE.

THE NAPHTHYLAMINES: 2-NAPHTHYLAMINE HAS DEMONSTRATED CARCINOGENICITY IN SEVERAL SPECIES INCLUDING MAN, RHESUS MONKEY, DOG, MOUSE, AND HAMSTER. 1-NAPHTHYLAMINE HAS BEEN STRONGLY ASSOCIATED WITH HUMAN BLADDER CANCERS. THESE TWO NAPHTHYLAMINES ARE NOT NORMALLY FOUND IN

NATURE, BUT THEY ARE FOUND IN CREOSOTE AND IN CIGARETTE SMOKE. THEY ARE SLIGHTLY SOLUBLE IN WATER AND COULD BE A CONTRIBUTING FACTOR TO CARCINOGENESIS, IF THESE WATERS ARE USED AS A POTABLE SOURCE. AQUATIC TOXICITY HAS ALSO BEEN ATTRIBUTED TO THE NAPHTHYLAMINES.

C. NEUTRAL OILS

CONTAINS THE FRACTION OF HYDROCARBONS WHICH INCLUDES NAPHTHALENES, ANTHRACENES, BENZENE, TOLUENE, XYLENE, ACENAPHTHENE, PHENANTHRENES, FLUORENE, PYRENES, AND CARBAZOLES. THE ABOVE MENTIONED COMPOUNDS ARE INCLUDED IN THE GROUP OF POLYCYCLIC AROMATIC HYDROCARBONS WHICH ARE CONSIDERED THE MAJOR COMPONENTS OF AND COMPRISE AT LEAST 75% OF CREOSOTE.

POLYCYCLIC AROMATIC HYDROCARBONS (PAH) HAVE BEEN WELL ESTABLISHED EXPERIMENTALLY AS CARCINOGENS. TISSUES AND ORGANS OF LABORATORY ANIMALS HAVE PROVIDED A WEALTH OF INFORMATION CONCERNING EXPOSURES TO PAH. IN MAN, HOWEVER, EXPOSURES ARE TO THE COMBINATIONS OF PAH AS THEY OCCUR IN SOOT, COAL TAR (CREOSOTE), PITCH AND MINERAL OILS, TOBACCO SMOKE, AND AUTO EXHAUSTS. ENVIRONMENTAL HUMAN EXPOSURE HAS BEEN CHARACTERIZED AS FAR BACK AS 1892, WHEN WORKERS IN THE COAL TAR INDUSTRY

WERE SHOWN TO DEVELOP SKIN CANCER. HUMAN SKIN CANCERS HAVE BEEN DESCRIBED AFTER EXPOSURE TO CREOSOTE OIL AND ANTHRACENE OIL.

EXPOSURE TO WORKERS IN THE INDUSTRY HAVE SHOWN SIGNIFICANT EXCESS DEATHS FROM LUNG CANCER, BLADDER CANCER, CANCER OF THE SKIN, AND SCROTUM. SUCH DATA HAS BEEN FOUND IN ENGLAND, HOLLAND, GERMANY, AND FRANCE. JAPANESE OBSERVATIONS CHARACTERIZED EXCESSES OF LUNG CANCER IN COAL TAR FUME EXPOSURE; ALSO NOTED WERE THAT LONGER DURATIONS OF EXPOSURE INCREASED THE MORTALITY, BEGINNING TEN YEARS AFTER THE EXPOSURE.

A 1968 REPORT OF THE LONDON, ENGLAND MEDICAL RESEARCH COUNCIL STATED THAT CARCINOGENICITY OF CRUDE OILS

(WHICH ARE IN COAL TAR) APPEARS TO LIE IN IMPURITIES WHICH BOIL ABOVE  $350^{\circ}\text{C}$ . FROM THESE FRACTIONS OVER 40 COMPOUNDS WERE ISOLATED, SEVERAL STRUCTURALLY SIMILAR TO POTENT CARCINOGENS. COMPOUNDS ISOLATED INCLUDED A WIDE RANGE OF AROMATIC HYDROCARBONS SUCH AS DI -, TRI - AND TETRA - METHYLNAPHTHALENES, PHENANTHRENES, CHRYSENE, AND ITS METHYL DERIVATIVES, PERYLENE, TRIPHENYLENE, AND TETRAMETHYLFLUORENE.

HETEROCYCLIC COMPOUNDS INCLUDED DI - AND TETRA-METHYL-DIBENZOTHIOPHENES, THIOMBENZFLUORENE AND TETRA- AND PENTAMETHYLCARBAZOLES.

THE ROLE OF THE VARIOUS PAH, AND HETEROCYCLIC COMPOUNDS PRESENT IN THE ENVIRONMENT (AIR, TOBACCO SMOKE, FOOD, AND/OR WATER) INDICATES THAT AN ACCURATE DETERMINATION OF THE CONTRIBUTION OF EACH CANNOT BE QUANTIFIED BUT THE EXISTENCE OF THE HAZARD AND/OR RISK IS PRESENT. THESE COMPOUNDS MAY ALSO PLAY A ROLE IN CARCINOGENESIS OR MAY ACT SYNERGISTICALLY TO PROVIDE A TOXIC MANIFESTATION WHEN EXPOSURE OCCURS. THE COMPOUNDS PRESENT IN CREOSOTE HAVE THE ABILITY TO PRODUCE TOXIC EFFECTS AND CANCER IN HUMANS AND LABORATORY ANIMALS. THEY SHOULD, THEREFORE, BE CONSIDERED DANGEROUS AND MINIMIZING EXPOSURE TO SUCH COMPOUNDS WOULD REDUCE POTENTIAL TOXIC EFFECTS. SUCH ACTIVITIES WHICH WOULD REDUCE DISCHARGES TO AREAS WHERE BIOLOGICAL EXPOSURE OCCURS SHOULD BE REDUCED TO ABSOLUTE MINIMA.

IT HAS BEEN SHOWN THAT AQUATIC ROOTED PLANTS, MACRO-INVERTEBRATES, MARINE AND TERRESTRIAL BIOTA, AND MAMMALIAN LIFE CAN BE ADVERSELY AFFECTED BY THE COMPOUNDS PRESENT IN CREOSOTE. THEREFORE CREOSOTE SHOULD BE CONSIDERED HAZARDOUS AND ANY EXPOSURE BE REDUCED SINCE THERE ARE NO SAFE OR SUB-THRESHOLD LEVELS FOR CARCINOGENS.

THIS OPINION IS BASED ON AVAILABLE PUBLISHED DATA WITH REGARDS TO ADVERSE EFFECTS OF COMPOUNDS COMMONLY FOUND IN CREOSOTE. IT IS ALSO THE AUTHORS' OPINION THAT REMOVING THIS MATERIAL WOULD PROVIDE A REQUISITE DEGREE OF SAFETY FROM POTENTIAL ADVERSE EFFECTS TO HUMANS, NON-PRIMATES, MARINE BIOTA AND THE ENVIRONMENT.

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